Radiometric Calibration Assessment of Commercial High Spatial Resolution Multispectral Image Products

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Background/Introduction

Describe the results from the University of Arizona group for the commercial high resolution sensors

- Follow similar outline as previous speaker
- Describe reflectance-based approach
  - Highlight differences from South Dakota State and Stennis Space Center efforts
  - Accuracy assessment
- Give results from work with the high resolution sensors
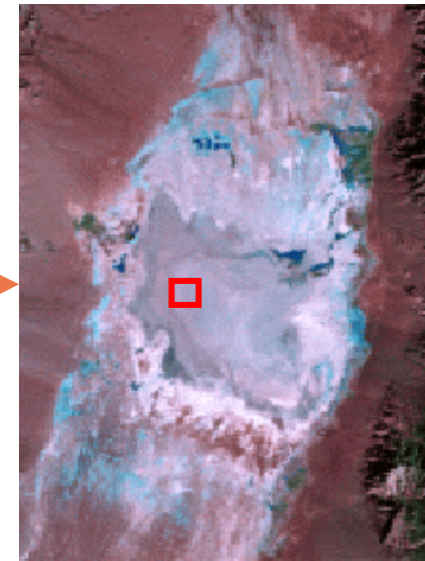- Brief comparison with work with other sensors
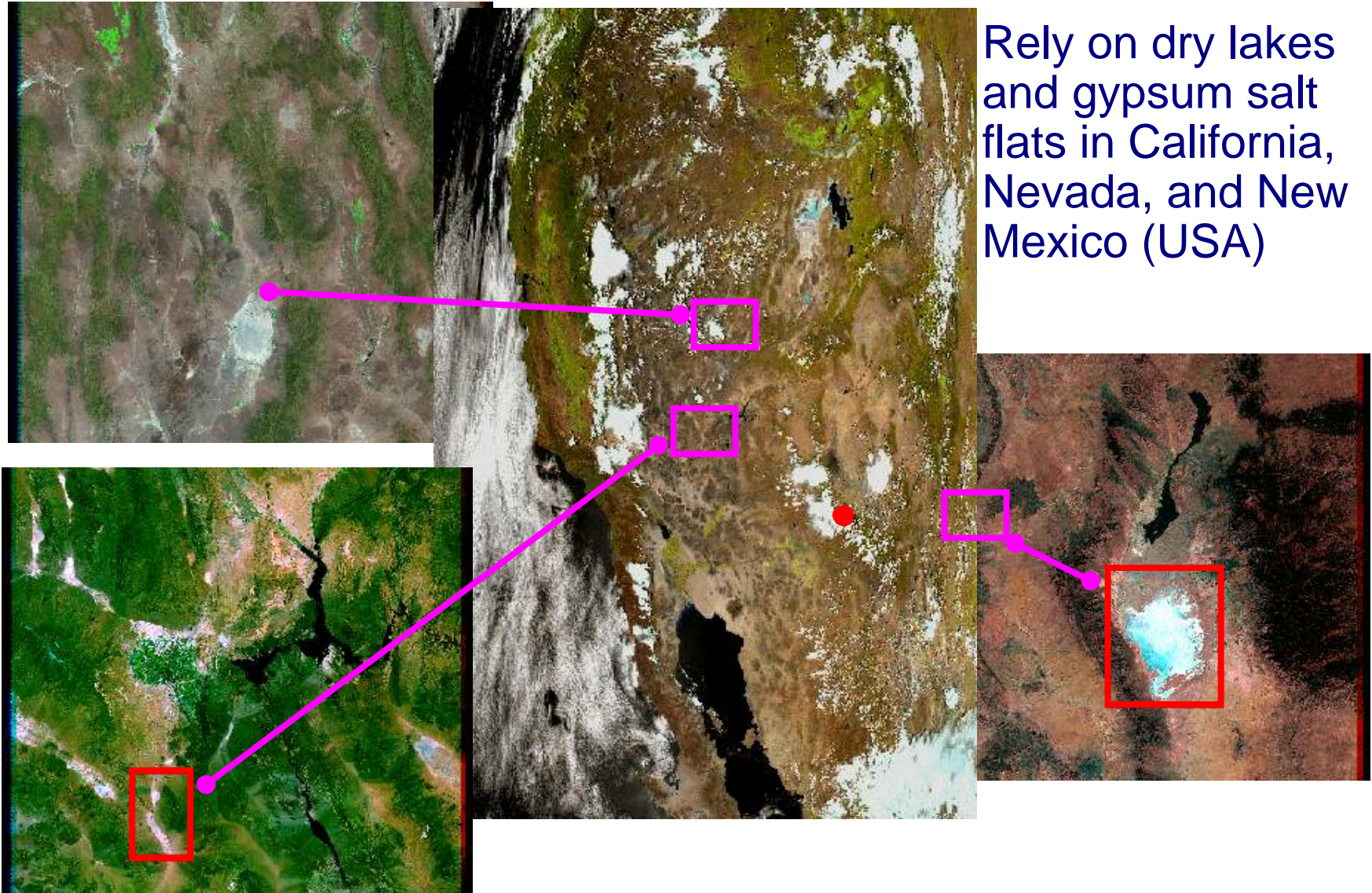
Reflectance-based approach

Method relies on atmospheric and surface characterization at the time of sensor overpass

Radiative Transfer Code

UofA test sites

Rely on dry lakes and gypsum salt flats in California, Nevada, and New Mexico (USA)

Test site selection

Site selection plays a role in the level of accuracy of the results

Resort Living

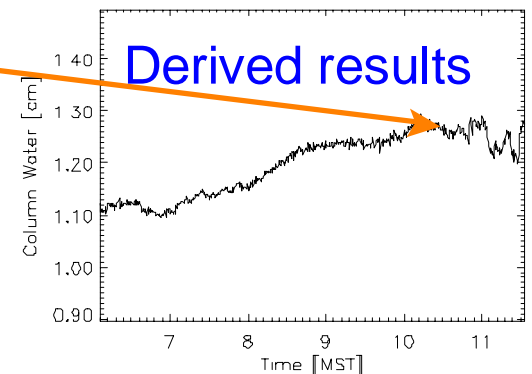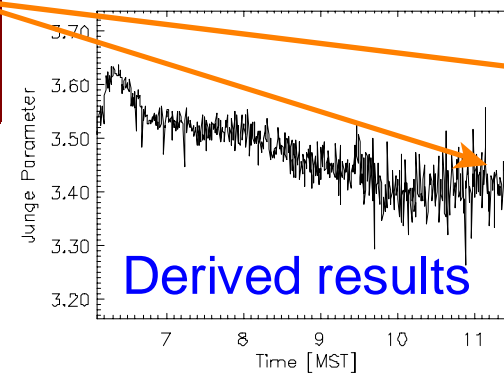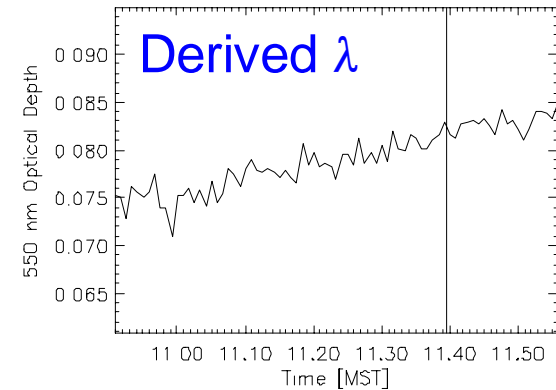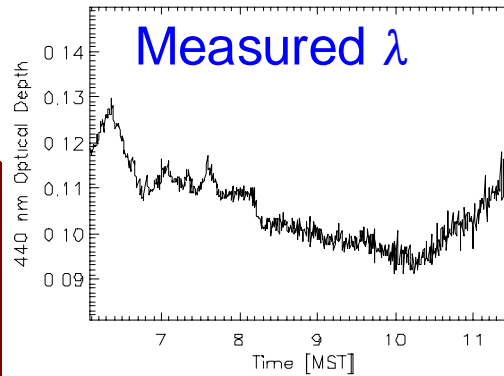Of course, there are the advantages of such places as Primm Valley Resort and a buffalo-shaped pool
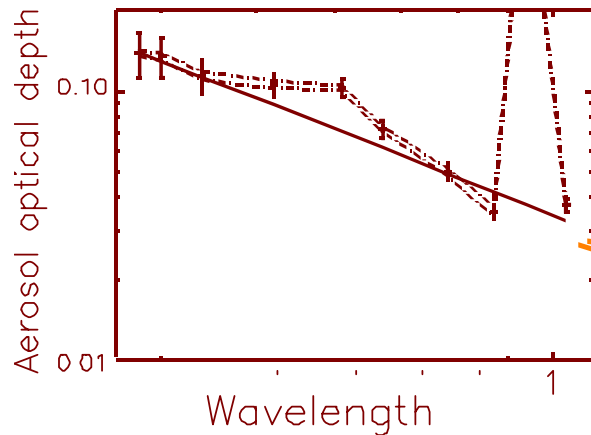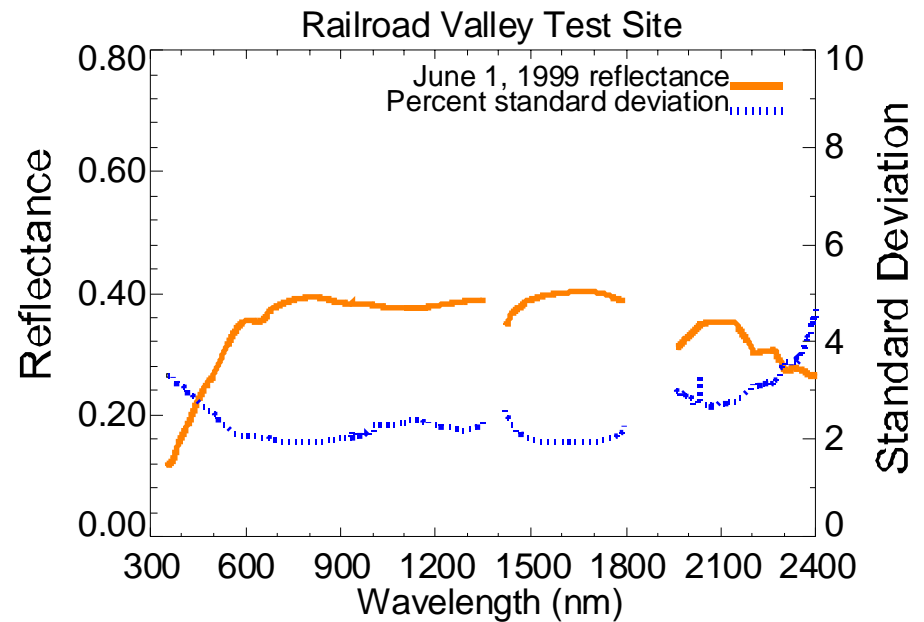
Aerosol parameters

Primary parameter is spectral transmittance which is used to derive spectral and temporal results

- Convert transmittance to optical depth
- Spectral optical depth used to retrieve
  - Column absorbers
  - Concentration
  - Aerosol size

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Surface reflectance retrieval

80 m

300 m

Railroad Valley Test Site

June 1, 1999 reflectance
Percent standard deviation

Reflectance

Standard Deviation

Wavelength (nm)
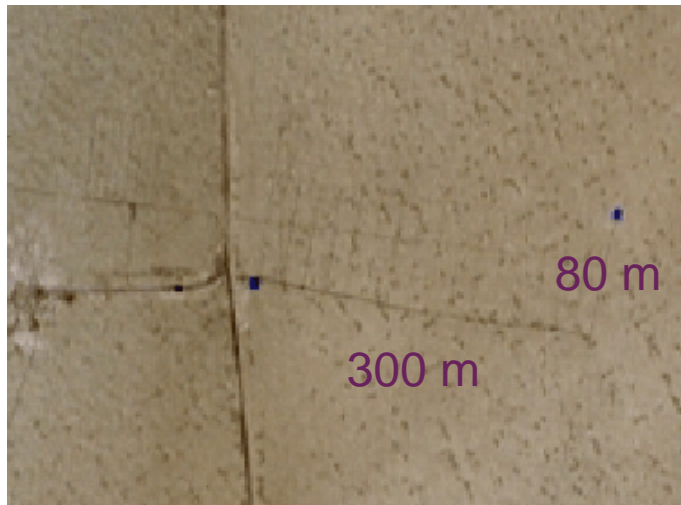
Accuracy/precision

Studies using ETM+, MODIS, and traceability to NIST standards show several key results

- There are no significant site-dependent effects in the data sets collected to date

- Precision (repeatability) of approach is at the 2.5% level (1-σ) in the mid-visible
  - Based on knowledge of measurement repeatability
  - Verified through theoretical modeling of uncertainties

- Accuracy is more difficult to prove but uncertainty estimates indicate a similar 2.5% value in mid-visible

- Improvements in the accuracy and precision will require improvements in characterization of surface reflectance

Data Sets

Two Ikonos images, three QuickBird and four Orbview data sets acquired for RSG since July '04

- Ikonos scenes were June 23, 2005 (Ivanpah) and August 28, 2005 (RRV)
  - Data collected at Ivanpah on June 18 for ETM+/Terra and August 28 was a Terra/ETM+ overpass day
- QuickBird scenes were Dec. 14, 2005 (RRV); July 8, 2005 (Ivanpah); and July 13, 2005 (RRV)
  - Data collected at Ivanpah on Dec. 15 for ETM+/Terra and on July 11 at RRV for Terra/ETM+
- Orbview scenes were July 11, 2004 (RRV), Aug. 28, 2004 (Ivanpah), Dec. 15, 2004 (RRV), and July 13, 2005
  - Data co-collected at with other sensors except for Aug. 28 data set

June 23, 2005 for Ikonos

Test sites used by UofA typically have clear skies with low aerosol loading

- June 23 date marked by smoke from forest fires
- Clearly visible from the ground and in some satellite data
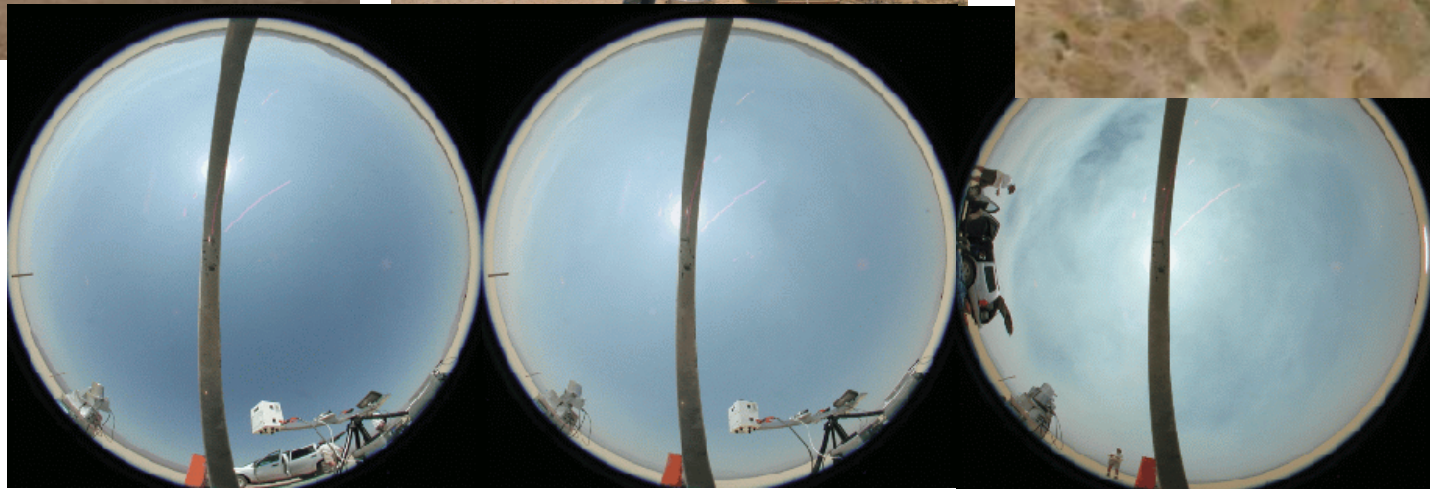
June 23, 2005 Ikonos

No noticeable effect in the Ikonos imagery from the date (below left) especially compared to QuickBird from July 8
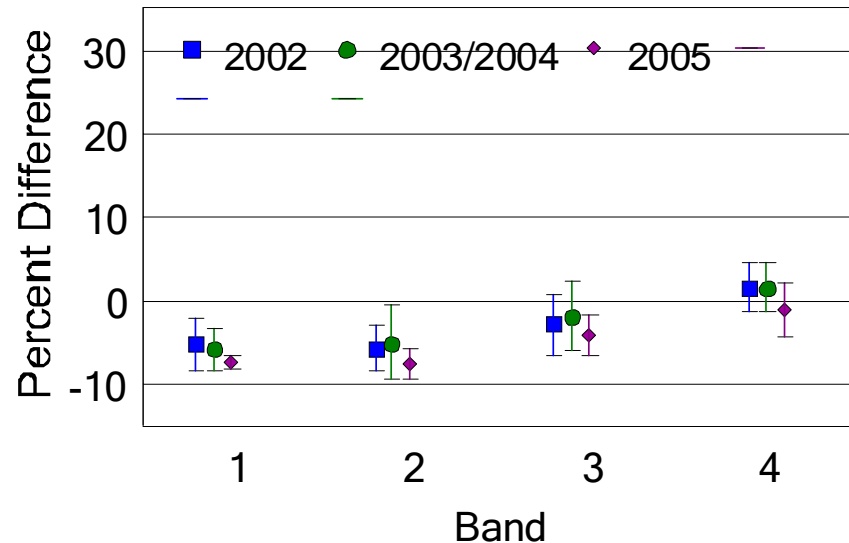
QuickBird Results

Have computed calibration results relative to the reported values for QuickBird

- Compute a percent difference between the ground-based values and the imagery

  - Determine average for the dates

  - Compute the standard deviation of that average

- Results for QuickBird show consistency with past years

"Precision" is similar to that for other sensors with more data points

Ikonos results

Have computed calibration results relative to the reported values for Ikonos

- Compute a percent difference between the ground-based values and the imagery

  - Determine average for the dates

  - Compute the standard deviation of that average

- Results for Ikonos show little variability with year

"Precision" is larger than that for other sensors with more data points but note 2005 data set
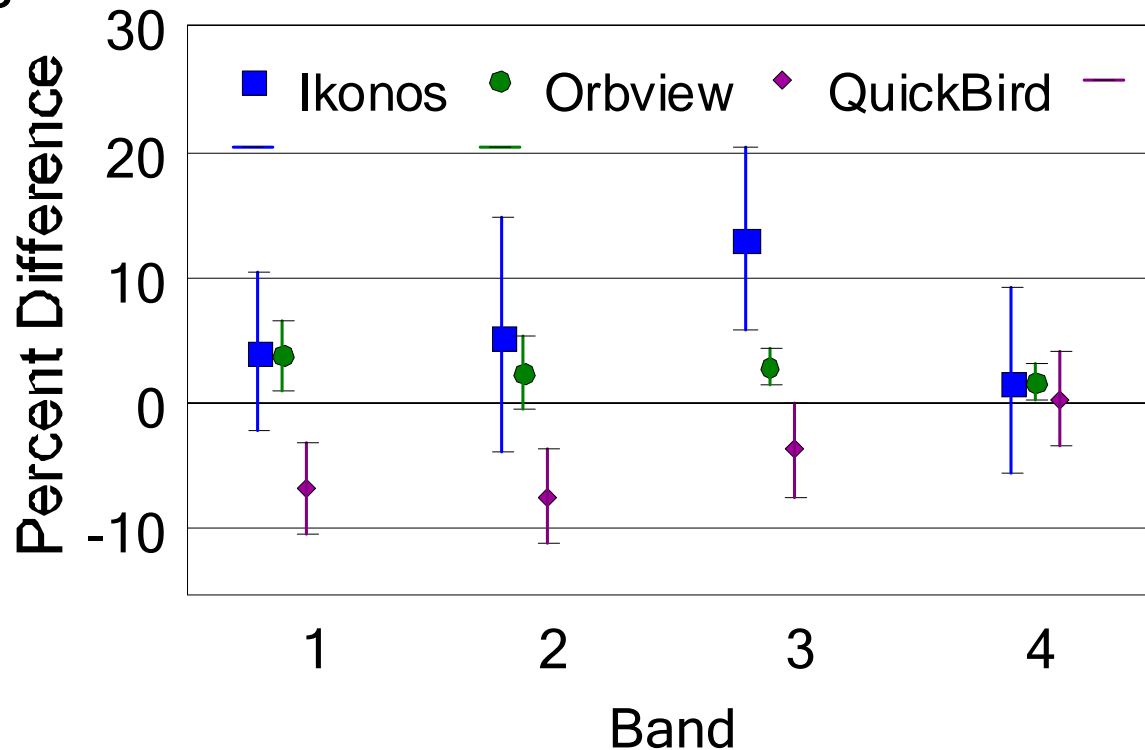
14
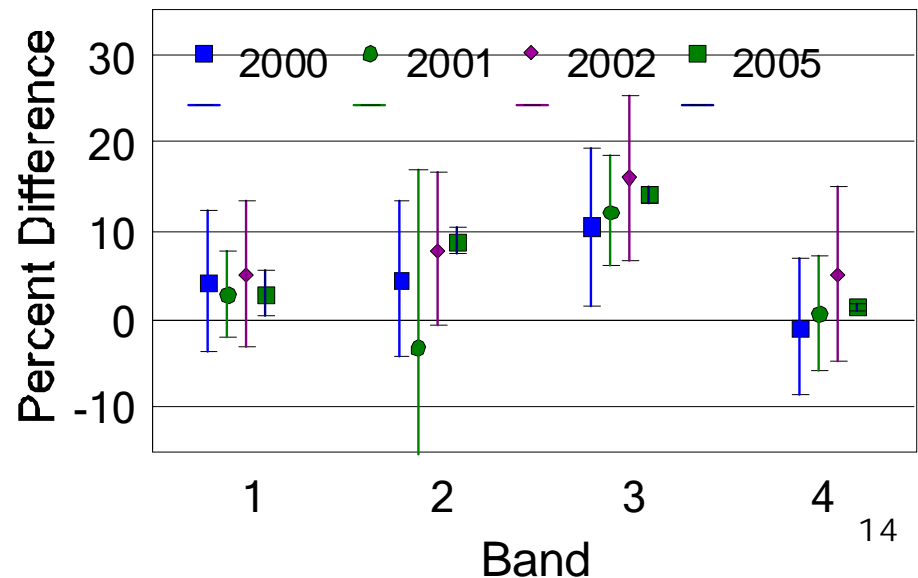
Orbview results

Have computed calibration results relative to the values for Orbview

- Include the Ikonos and QuickBird results for reference
- The advantage of reflectance-based method is that it can be used to determine a "cross-calibration" between sensors
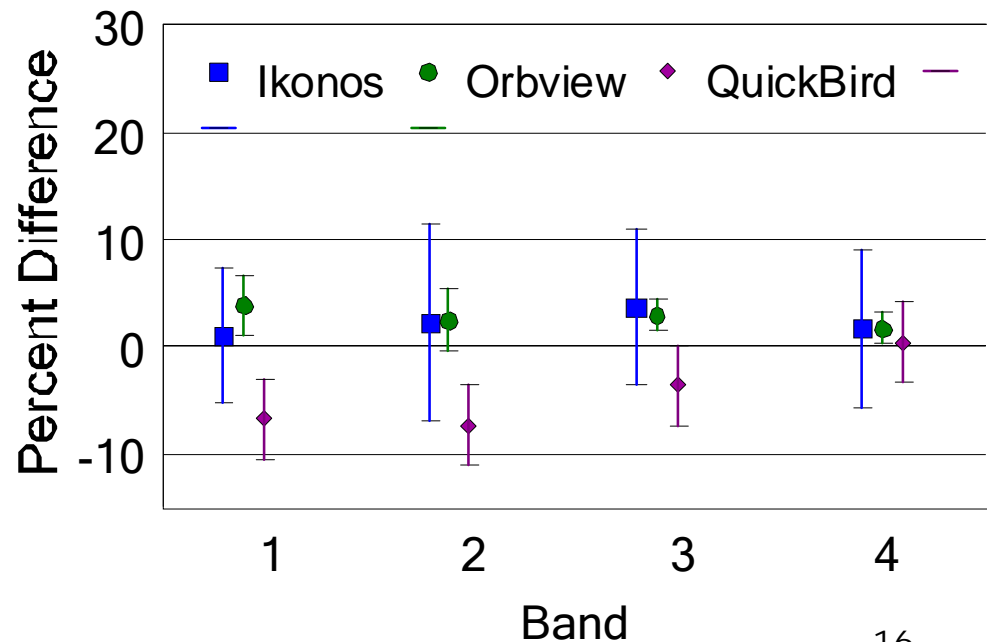
Ikonos redux

Behavior of band 3 prompted an additional look at the Ikonos data

- Did not see such an effect in the Stennis-based results (as will be seen)

- Opted to recompute the results with a change in the approach to band averaging

Ikonos-supplied calibration is band integrated

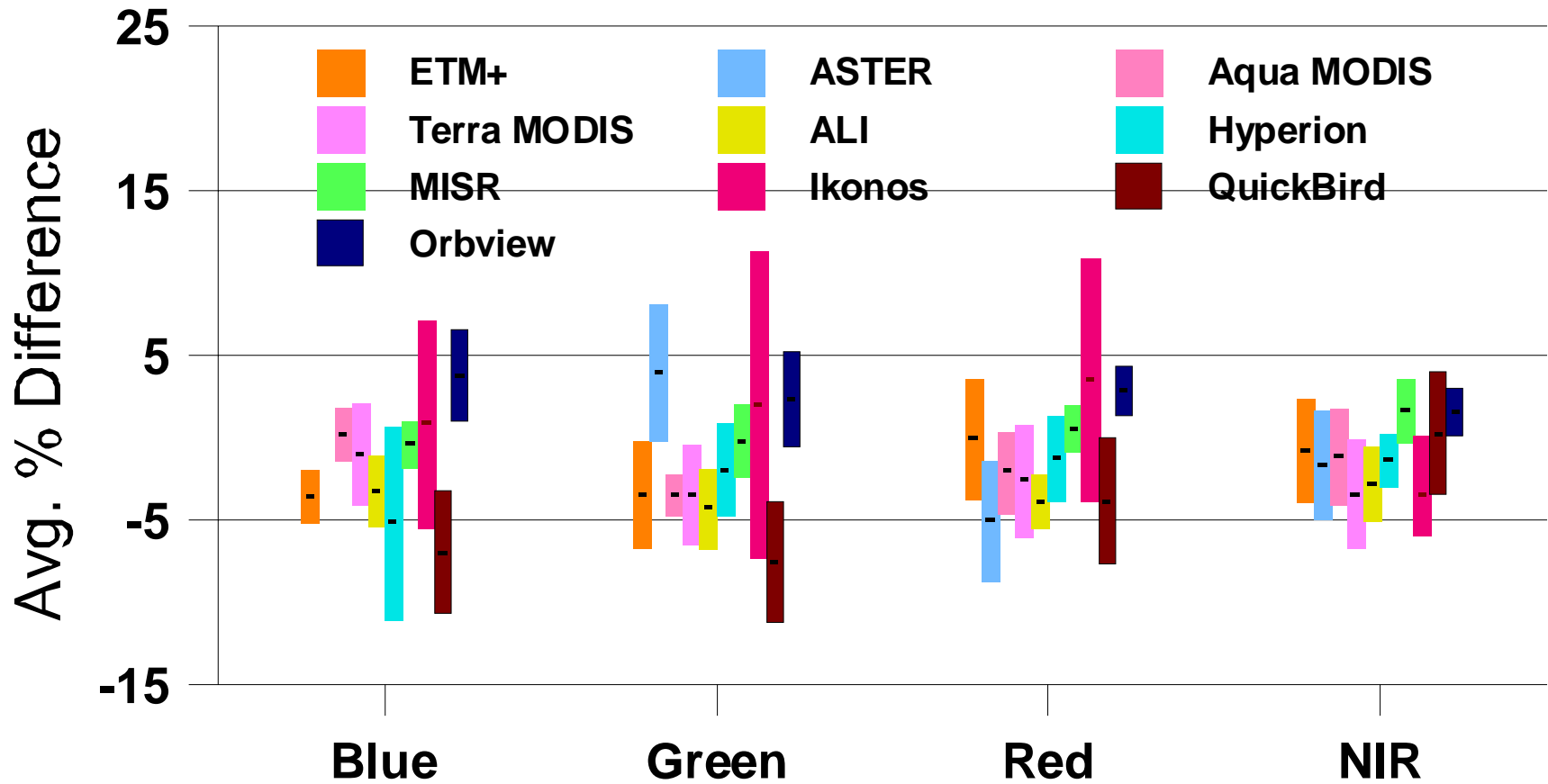Conversion can use either FWHM or integral approach

New results are integral based

Overall results

Comparisons can then be made amongst other sensors of varying spectral and spatial resolution

Summary/conclusions

The use of three independent groups continues to prove valuable in understanding these sensors

- Subtle band-averaging effect would not have been found otherwise (along with collaboration with the companies)

- UofA results for the high resolution commercial sensors are of similar quality as those of other sensors

  - High-resolution results rely on fewer data points

  - Still obtain similar levels of precision

  - Confidence in results is strengthened through coincident or near-coincident collects with other systems

- Look forward to further work to see if the quality of the 2005 data sets can be repeated